



Body CT: What is a Good Exam?

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DISCLOSURES

Research Support:

Siemens Healthcare

Off Label Usage

None



Overview

- “Good” exam
- Optimization for body imaging
 - organs
 - diseases
 - superfluous imaging
 - implementation
- “Diagnostic image quality”



The “Good” Exam



The “Good” Exam

- Justified



The “Good” Exam

- Justified

Benefit



Risk



The “Good” Exam

- Justified

Benefit



Risk

“An alternative way of stating [benefit] is that the risk of not performing the examination must exceed the risk of the examination.”



Justification

- Based on patient risk
 - Symptomatic
 - Asymptomatic
- Appropriateness
 - Compared to alternatives
- Ameliorating Factors
 - Patient co-morbidities & compliance
 - Local expertise & availability



Risk & Benefit
*unique for each
individual*



The “Good” Exam



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ACR Homepage

Q&S Resources Home

Guidance Resources Home

Appropriateness Criteria Home

Practice Guidelines and Technical Standards Home

Additional Resources

Manual on Contrast Media

Guidance Document on MR Safe Practices: 2007

White Paper on Radiation Dose in Medicine

Radiology Safety Resources

Home | Quality & Safety Resources | ACR Appropriateness Criteria®

ACR Appropriateness Criteria®



The ACR Appropriateness Criteria® are evidence-based guidelines to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition. By employing these guidelines, providers enhance quality of care and contribute to the most efficacious use of radiology.

The guidelines are developed by expert panels in diagnostic imaging, interventional radiology, and radiation oncology. Each panel includes leaders in radiology and other specialties. There are currently 167 topics with over 800 variants in the September 2009 Version.

The ACR allows individuals to use the ACR Appropriateness Criteria® for research, scientific, and / or informational purposes only. If you wish to use the ACR Appropriateness Criteria for other reasons, please contact the ACR at acr_ac@acr.org or 703-648-8900 for permission and licensing information.

ACR Appropriateness Criteria® Search Engine

This search engine allows you to search for clinical conditions found within the ACR Appropriateness Criteria® documents.

[Click here](#) to use our ACR Appropriateness Criteria® Search Engine

Anytime, Anywhere™ Application for Handheld Electronic Devices Now Available

In collaboration with Skyscape, the ACR has developed the Anytime, Anywhere™ application for handheld electronic devices as an alternative solution to radiology benefit management companies or computerized physician order entry systems that do not contain the ACR Appropriateness Criteria® guidance. This application provides instant, point-of-care access to all of the 167 topics, which can be directly downloaded on to the iPhone, Blackberry, Palm, or other PDAs, smart phones or handheld electronic devices. The content includes topics from expert panels in breast, cardiac, gastrointestinal, musculoskeletal, neurologic, thoracic, urologic, pediatric, vascular, and women's imaging, as well as interventional radiology and radiation oncology.

Diagnostic Imaging Topics

Topics with an asterisk (*) include pediatric imaging recommendations.

There are ten diagnostic imaging expert panels.

Breast Imaging

Cardiac Imaging

Gastrointestinal Imaging



The “Good” Exam

American College of Radiology ACR Appropriateness Criteria®

Clinical Condition:

Crohn's Disease

Variant 1:

Adult; initial presentation (abdominal pain, fever, or diarrhea); Crohn's disease suspected.

Radiologic Procedure	Rating	Comments	<u>RRL*</u>
CT abdomen and pelvis with contrast (CT enterography)	9		High
X-ray small-bowel follow-through	7		Med
CT abdomen and pelvis with contrast (routine)	6		High
X-ray contrast enema			
MRI abdomen and pelvis with contrast (MR enterography)			
X-ray abdomen			
US abdomen and pelvis	5		
US pelvis endorectal	3		
Tc-99m HMPAO leucoscintigraphy	3		
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			

Not linked with suggested acquisition protocols

CROHN'S DISEASE

James MPH²; MD⁴; MD⁶; MD⁸; Pasheem Ezzam, MD⁹; Frank H. Miller, MD¹⁰; Don C. Rockey, MD⁹; Gary S. Sudakoff, MD¹⁰; Richard Gunderman, MD, PhD¹¹; Brian D. Coley, MD.¹²

Summary of Literature Review

Crohn's disease (CD) is a chronic inflammatory disease involving the gastrointestinal tract. The etiology is unknown, but evidence suggests that a genetic predisposition combined with an abnormal interaction between the gut and enteric microorganisms may play a role in the pathogenesis. Patients usually present with the

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[3]. The succ
subtypes of
nature and e
sufficient for
CD—he or s



The “Good” Exam

- Justified

- Optimized

Use doses that are as low as reasonably achievable (ALARA) without compromising diagnostic task.



The “Good” Exam

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- Optimized

Use doses that are as low as reasonably achievable (ALARA) without compromising diagnostic task.

Adapts CT acquisition to patient and disease



The “Good” Exam

- Justified

- Optimized

Considers many other factors other than radiation dose

- type, rate of IV contrast, phase of enhancement
- type, amount & timing of enteric contrast
- alternative modalities
- patient-specific factors



Optimization

*Maximizing disease detection while
minimizing dose and non-radiation risk*

- CT acquisition parameters that affect
 - spatial & temporal resolution, contrast/noise, timing
- Patient preparation - oral and intravenous contrast delivery
- Visual assessment of critical structures & relevant CT data
 - radiologist review
 - image reconstruction & post-processing (3D, 2D MPR, DE)



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Optimization of CT Acquisition

Disease/Patient Consideration

Parameters Under User Control



Optimization of CT Acquisition

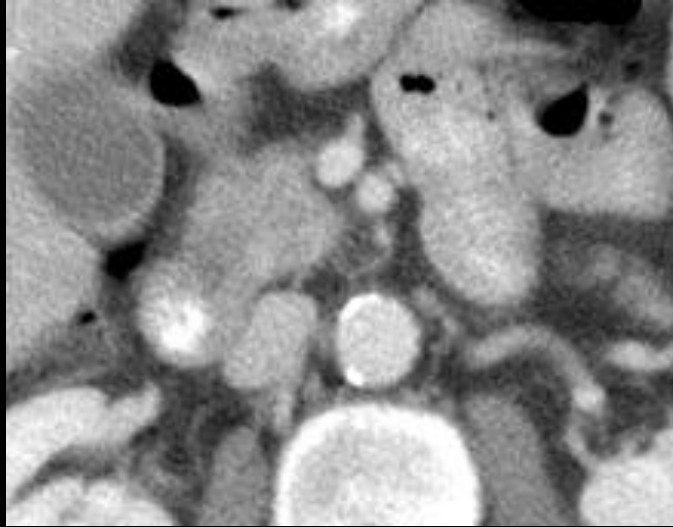
Disease/Patient Consideration

- Size of index pathology
- Temporal importance of enhancement, # phases
- Contrast (lesion-to-background)
- Organ
- Size of patient
- Lesion depiction
- Consequence of false negative

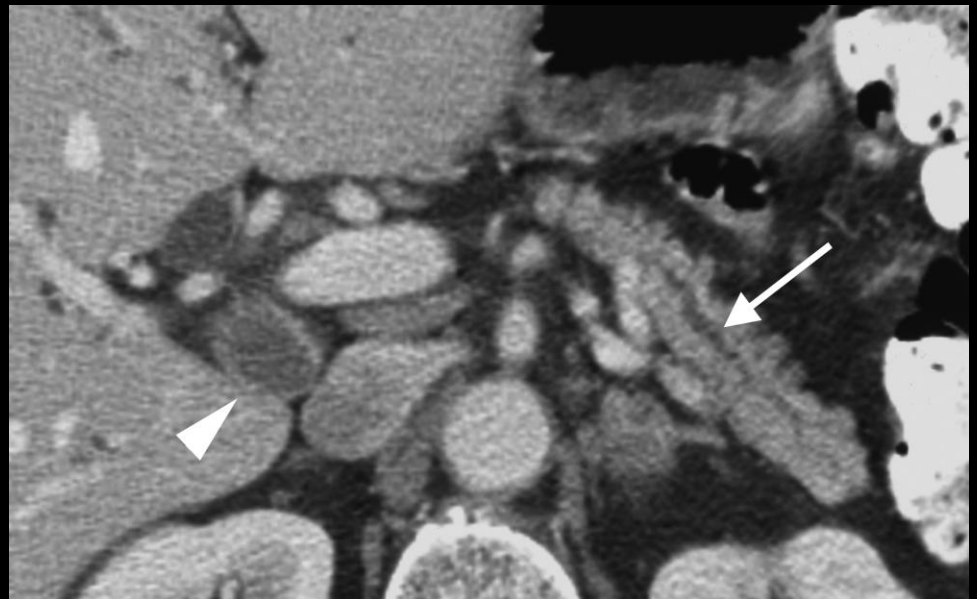
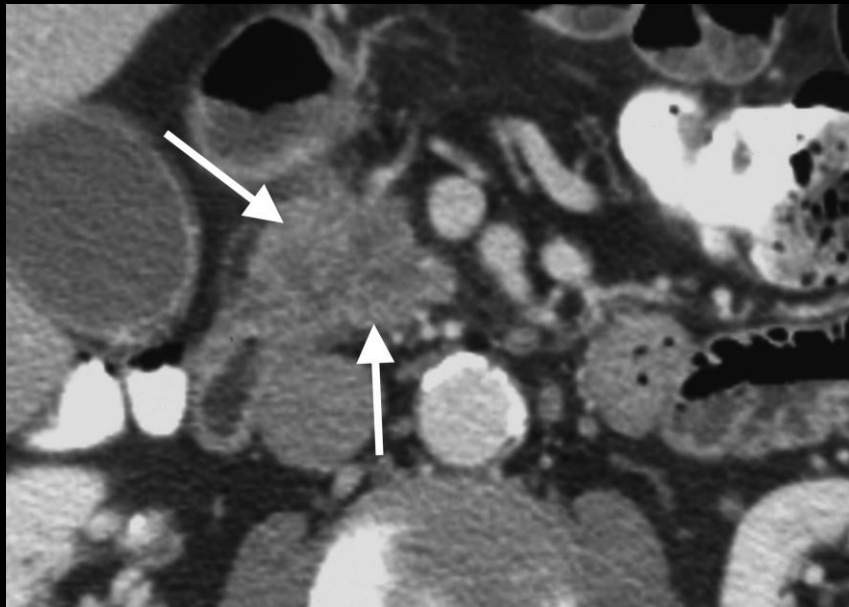
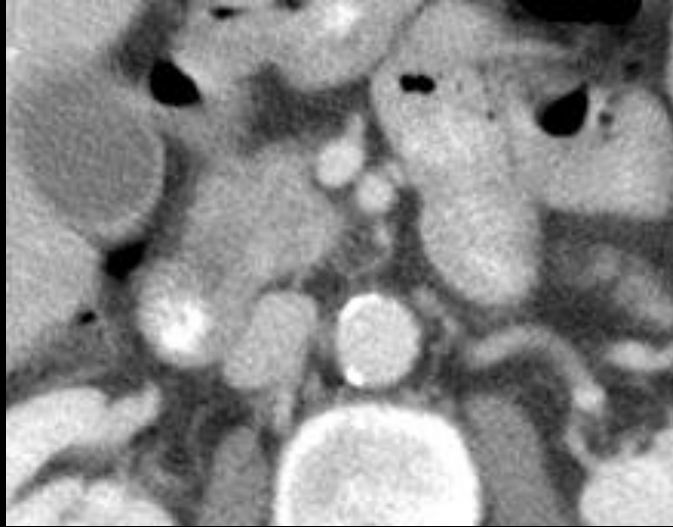
Parameters Under User Control

- Collimation, slice thickness
- Table speed, heat capacity of tube, collimation, scanner
- Oral & IV contrast, rate of injection, kV
- Tube current, slice thickness
- Slice thickness, tube rotation, kV, generator power, scanner
- Image reconstruction & post-processing, dual energy
- Dose, image reconstruction

Slice Thickness



Slice Thickness





Slice Thickness

- Survey or follow-up – 5 mm
- Liver, pancreas, bowel - ≤ 3 mm



Slice Thickness and Dose

- Dose reduction possible with thin slices when a lot of contrast defines lesion
 - Colonography
 - Enterography
 - Renal stone



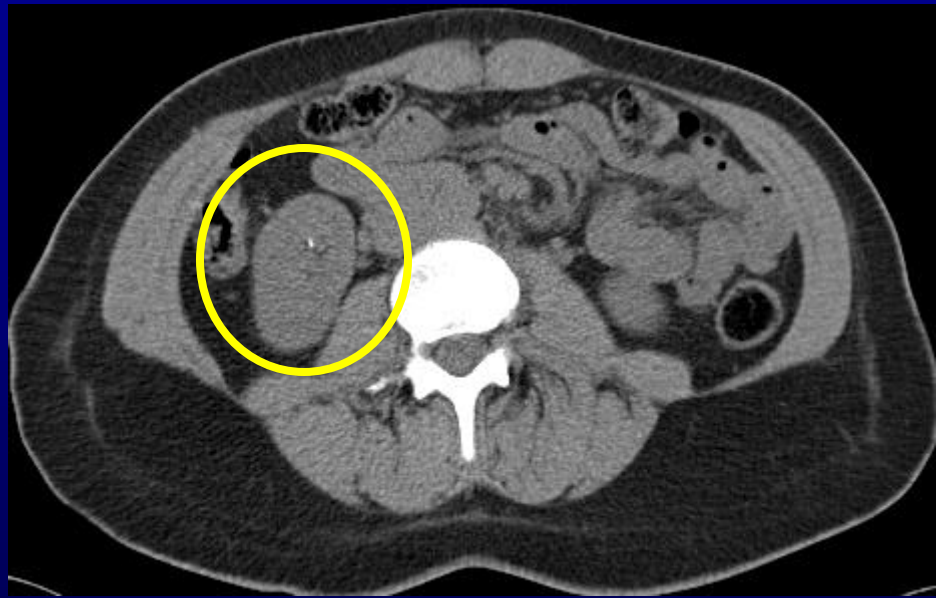
Low Dose Renal Stone CT

Indications

- Known stone disease + prior CT
- Pts with symptoms highly suspicious for ureteral stone (i.e., acute renal colic)
- Pregnant patients with equivocal US results (US is 1st line imaging test)
- Pre-contrast imaging for CT Urography
- Exclusions - > 50 cm or metal
- Drop QRM from 240 to 100 mAs



155 lbs (71 kg)



11-06-06

100 effective mAs



10-23-06

240 effective mAs

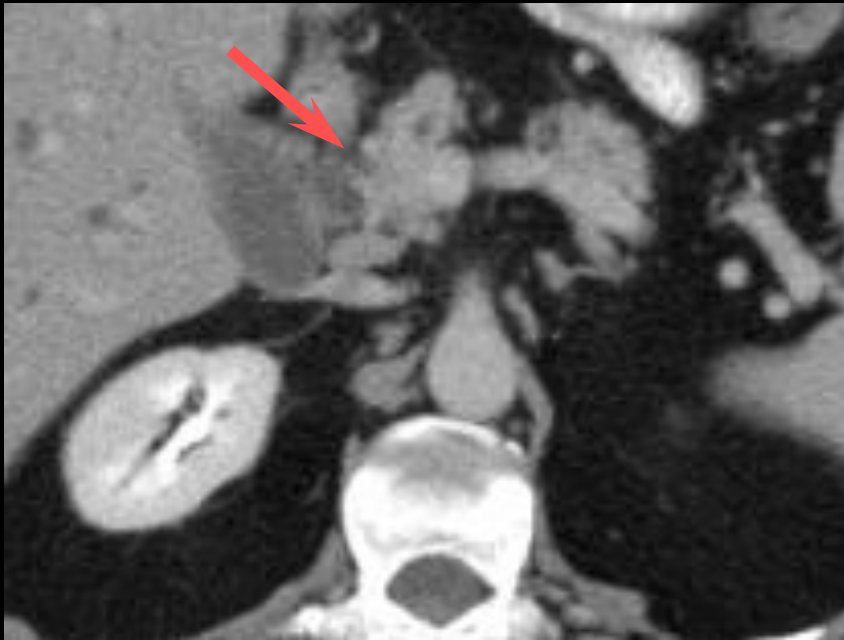


Slice Thickness and Dose

- Dose reduction not a good idea for subtle tumors in complex, solid organs
 - Pancreas
 - Liver
- Our dose settings are about 30% higher in liver and pancreas CA



Phase of Enhancement



Portal Phase



Pancreatic Phase
(lower kV)



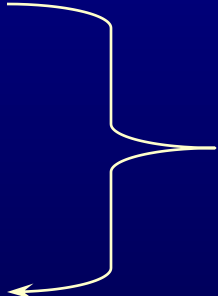
Phases of Enhancement

Designed to maximize organ or tumor enhancement

- Early arterial
- Late arterial
- Pancreatic
- Enteric
- Portal
- Delayed



Arteries & Tumor Blush



Maximal organ enhancement



Tumor Washout & GU



Phases of Enhancement

Designed to maximize organ or tumor enhancement

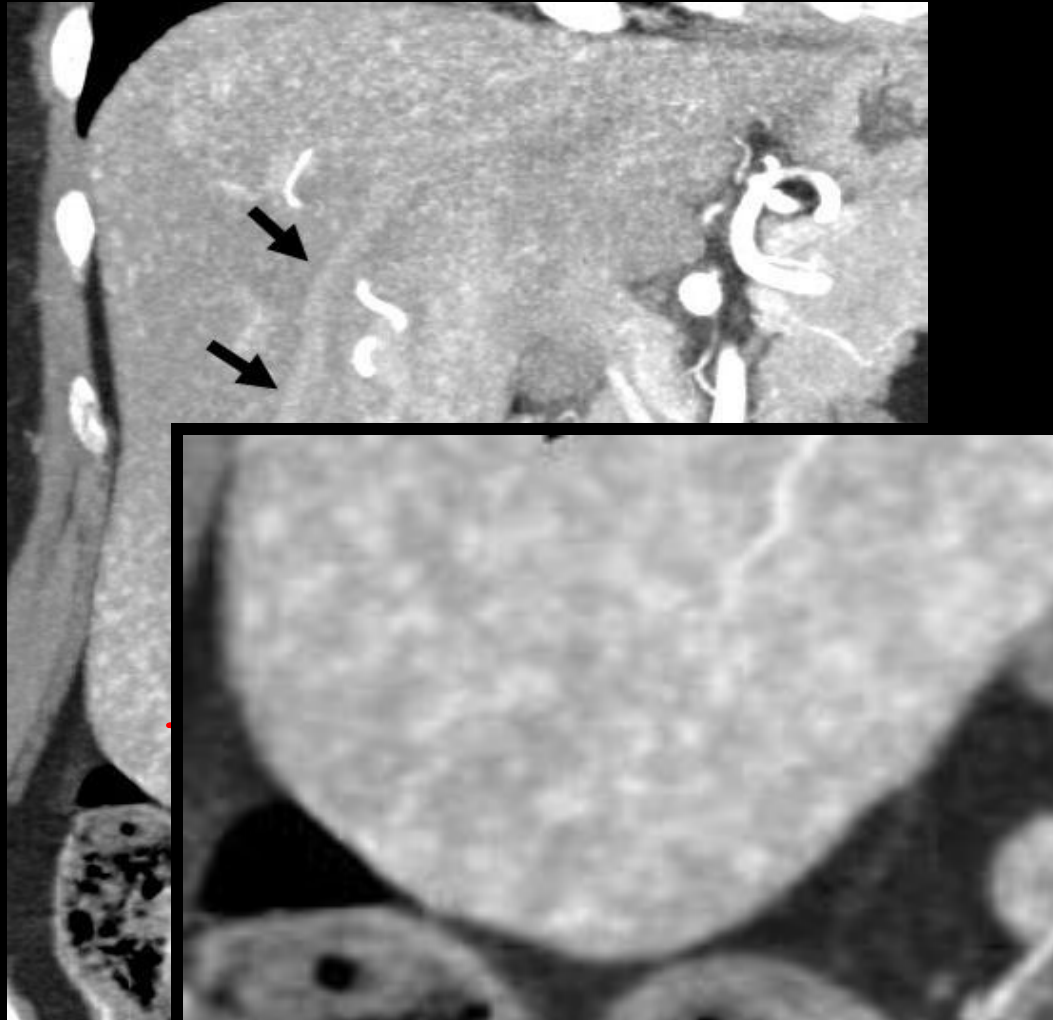
- Early arterial
 - Bolus-triggered, 15 – 20 s – CTA, HHT, islet cell
- Late arterial
 - 18 sec post trigger, 35 s
 - HCC
- Pancreatic
 - 20 sec post trigger, 45 s
 - Max panc to tumor, p ACA
- Enteric
 - 20 sec post trigger, 50 s
 - Max bowel enhancement, Crohn's
- Portal
 - 40 sec post trigger, 65 – 70 s
 - Portal + HV opacified, workhorse
- Delayed
 - 3 – 5 minutes
 - Tumor washout, Urothelium



Phases of Enhancement

- Liver – arterial (early or late), portal, delayed
- Pancreas – pancreatic, portal
 - Use both for first time tumor and pancreatitis
 - Pancreatitis f/u with single phase
- Kidney – CM(30), Arterial (45), Nephrographic (90-100), Delayed
- Small bowel – enteric, \pm arterial, \pm delayed
 - Multiphase scanning – mesenteric ischemia, occult GI blood loss
- Colon – portal or enteric

Spatial & Temporal Resolution Increase Benefit





Common Tumor Rule Outs

- Liver – R/O HCC
 - Higher dose
 - 2 – 3 mm slice
 - Late arterial (tumor blush), portal, delayed phase (tumor washout)
 - Axial + coronal
- Pancreas – R/O pancreatic adenocarcinoma
 - Higher dose
 - 2 - 3 mm slice (pancreatic duct)
 - Pancreatic (tumor detection), portal (veins & liver)
 - Axial + coronal



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Disease/Patient Consideration

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- Lesion depiction
- Consequence of false negative

Parameters Under User Control

- Collimation, slice thickness
- Table speed, heat capacity of tube, collimation, scanner
- Oral & IV contrast, kV
- Tube current, slice thickness
- Slice thickness, tube rotation, kV, generator power, scanner
- Image reconstruction & post-processing, dual energy
- Dose, image reconstruction



Size of the Patient

Technique should *always* be adapted to patient size

- Minimize dose
- Maximize contrast (?kV, oral and IV) and image quality



Adapting for Smaller Patients

- AEC
- Technique charts
- kV selection
- Decreased dye load
- Oral Contrast



Morbidly Obese Imaging

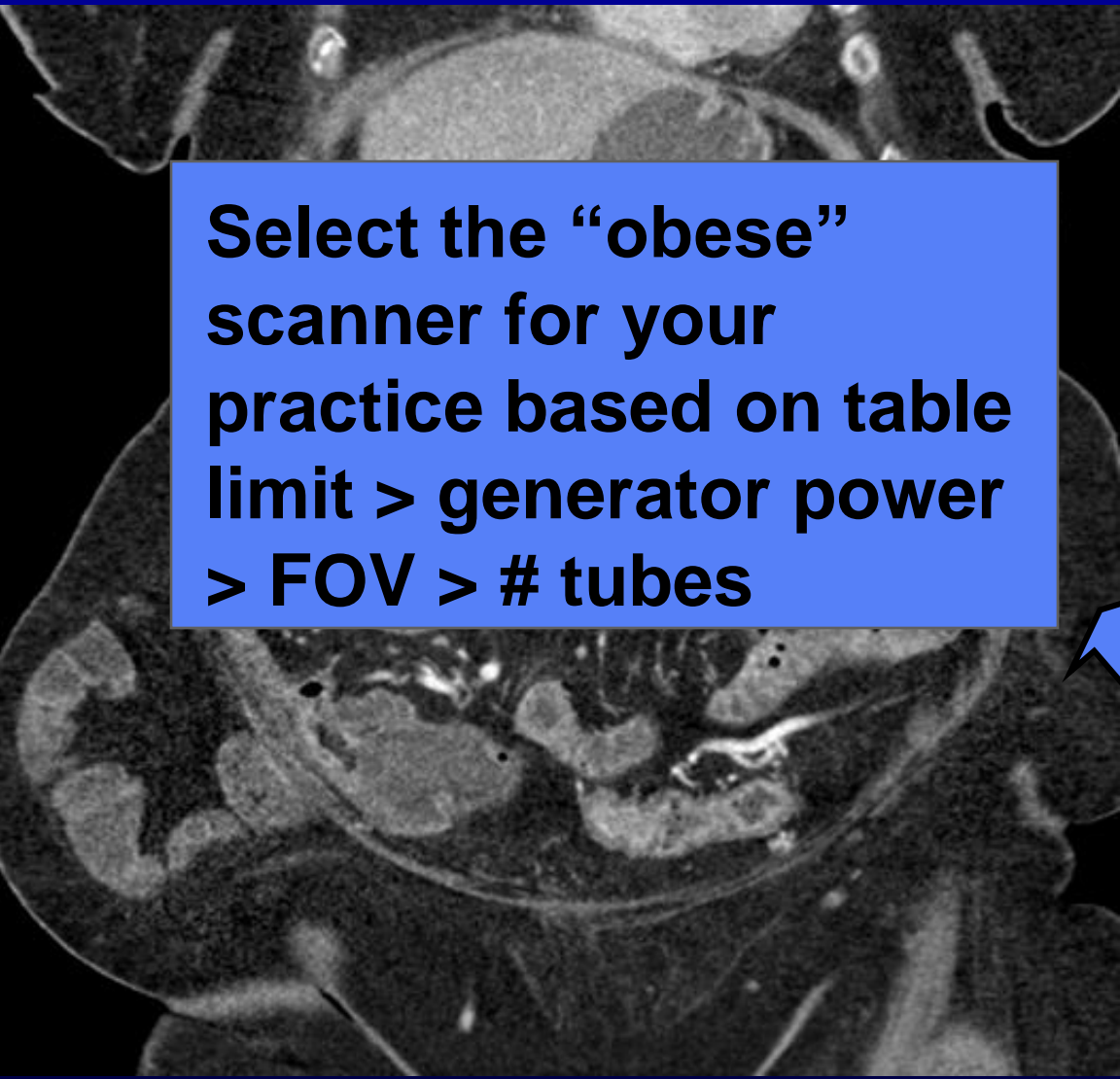


Problems

- Image quality (artifacts, CT number)
- Time of scan > breathhold, multiphase timing
- Heat capacity
- FOV
- Table limit



Morbidly Obese Imaging



**Select the “obese”
scanner for your
practice based on table
limit > generator power
> FOV > # tubes**

Problems

- Image quality (artifacts, CT number)
- Time of scan > breathhold, multiphase timing
- Heat capacity
- FOV
- Table limit



Morbidly Obese Imaging

- Increase mAs at 120 kV (slow table speed)
- Choose a thicker detector width (e.g., 24 x 1.2 mm) & slice thickness
- Increase tube energy to 140 kV
- Employ dual source, if possible
- Slow rotation time to 1 rot/s

Problems

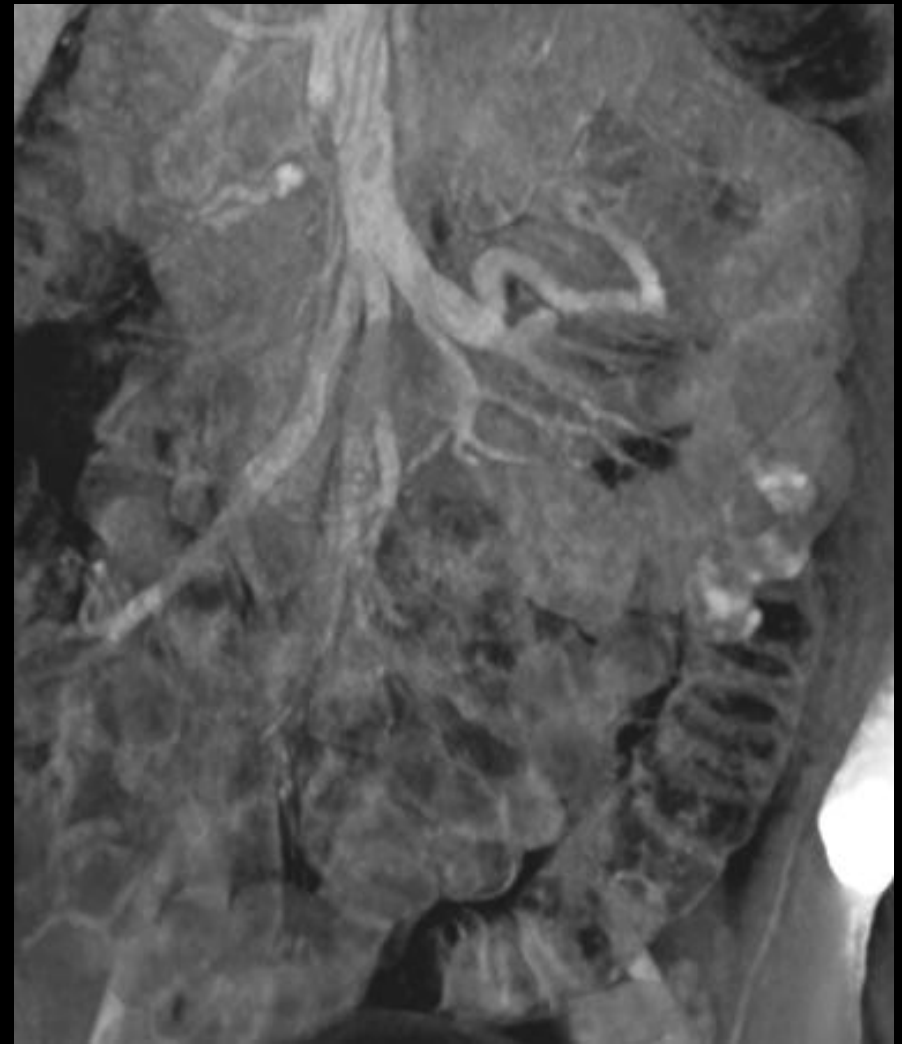
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Optimization

*Maximizing disease detection while
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Oral and Intravenous Contrast Increase Benefit



Individualization of Patient Prep

Parameters to Consider

- Iodinated contrast (type, injection rate/delivery)
- Enteric contrast
- Bowel prep and tagging

Disease/Patient Consideration

- Organ, temporal enhancement
- Lesion-to-background contrast differences
- Need for bowel distension & volume challenge
- Colonography



Iodinated IV Contrast

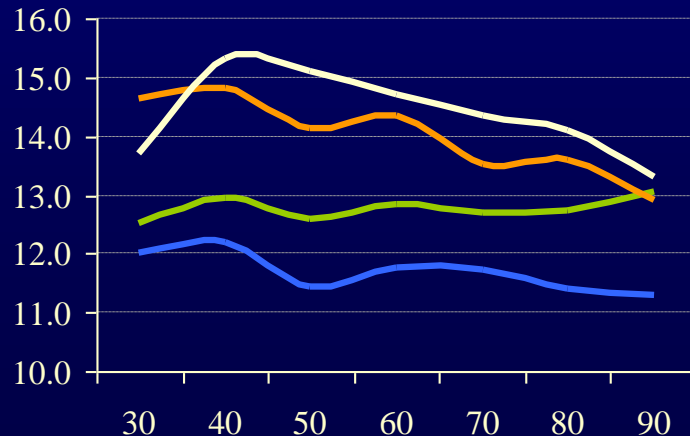
- Highly idiosyncratic
- Concentration and rate of injection affect enhancement

PREP DELAY TABLE*		
INJECT AT THE HIGHEST RATE POSSIBLE		
Injection Rate (cc/s)	Pancreatic Phase (sec)	Portal Phase (sec)
3	45	70
4	40	65
5	35	60

- Fixed amount/rate vs. weight-based/fixed injection duration, blended

Oral Contrast Agents

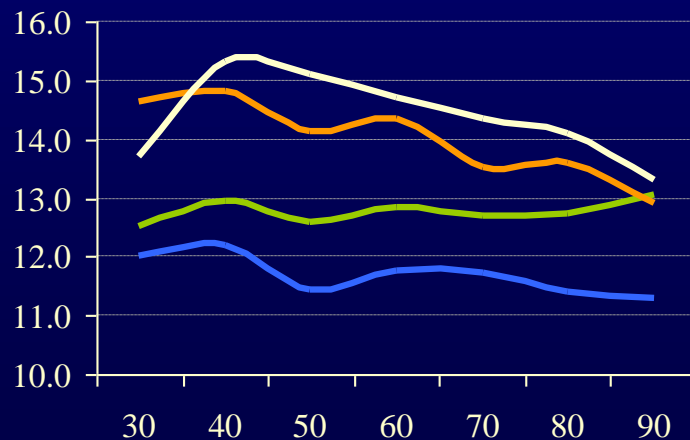
- Positive oral contrast agents – ca, screen
 - Barium or iodine
- Neutral agents – SB, CTA
 - Water, PEG, Volumen (sorbitol)



Young BM, et al. JCAT 2008

Oral Contrast Agents

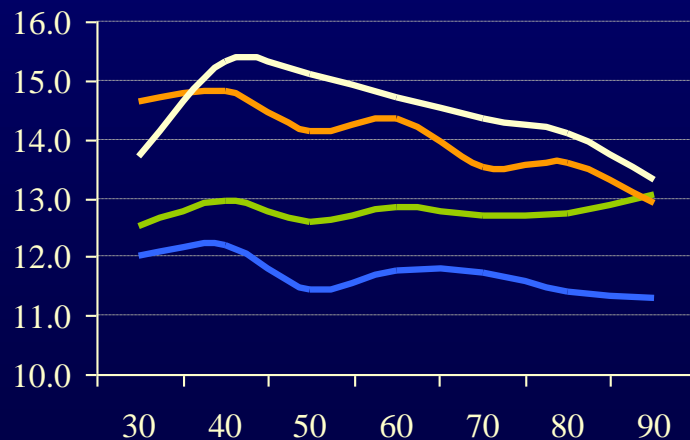
- Administration
 - Amount
 - Timing of aliquots
 - Timing of scan
 - Bathrooms



Young BM, et al. JCAT 2008

Oral Contrast Agents

- Positive ~ 500 x 2, 20 min apart
- Neutral ~ 500 x 3 + 500 water, 15 minutes apart



Young BM, et al. JCAT 2008



Optimization

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Individualization of Visual Evaluation

Disease/Patient Consideration

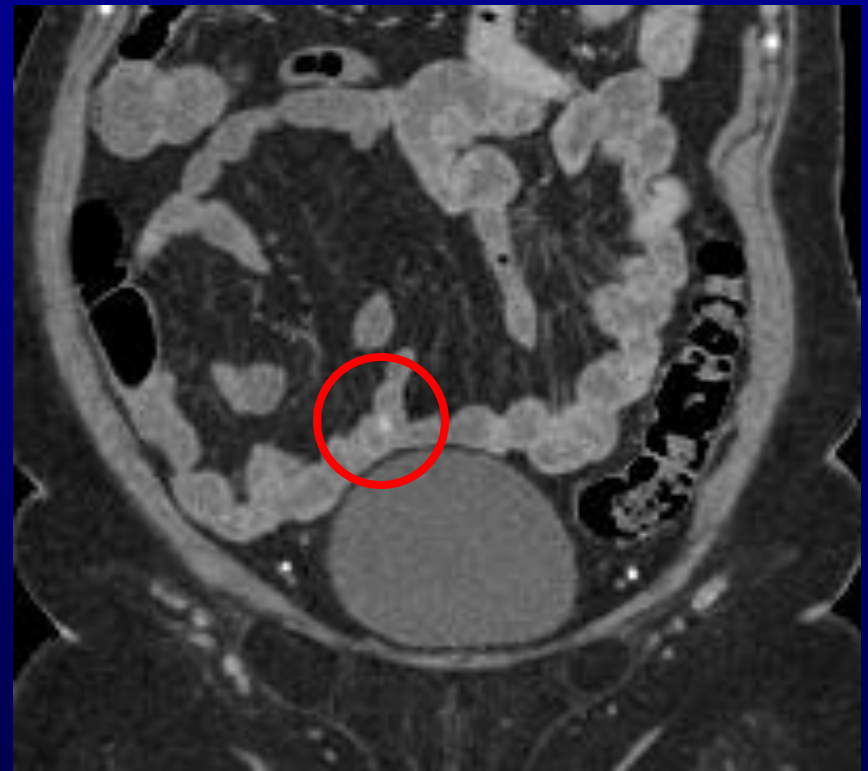
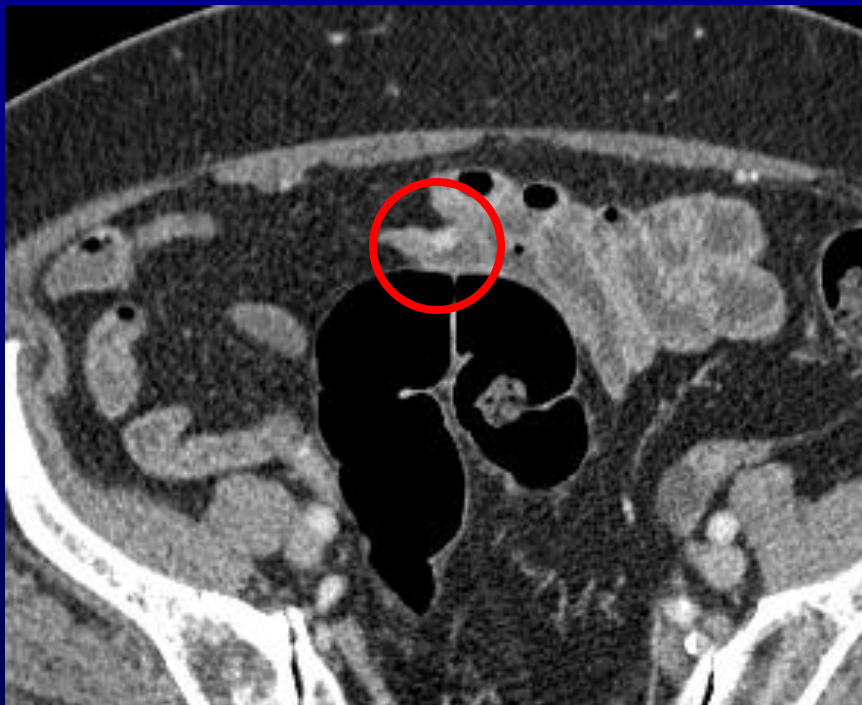
- Will two planes increase conspicuity?
- ? 3D structure with large contrast differences
- Will material classification assist in diagnosis?
- Are the images too noisy?

Review/Recon/Processing

- Automatic 2D MPR's
- Interactive 3D (angio, colon)
- Dual energy processing
- Noise reduction methods



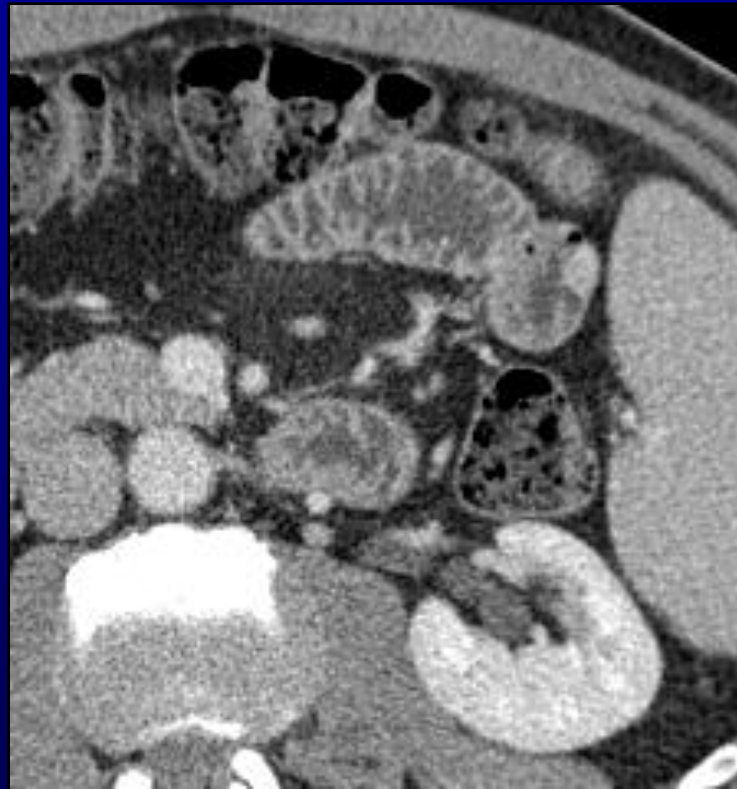
Coronal Images Increase Confidence



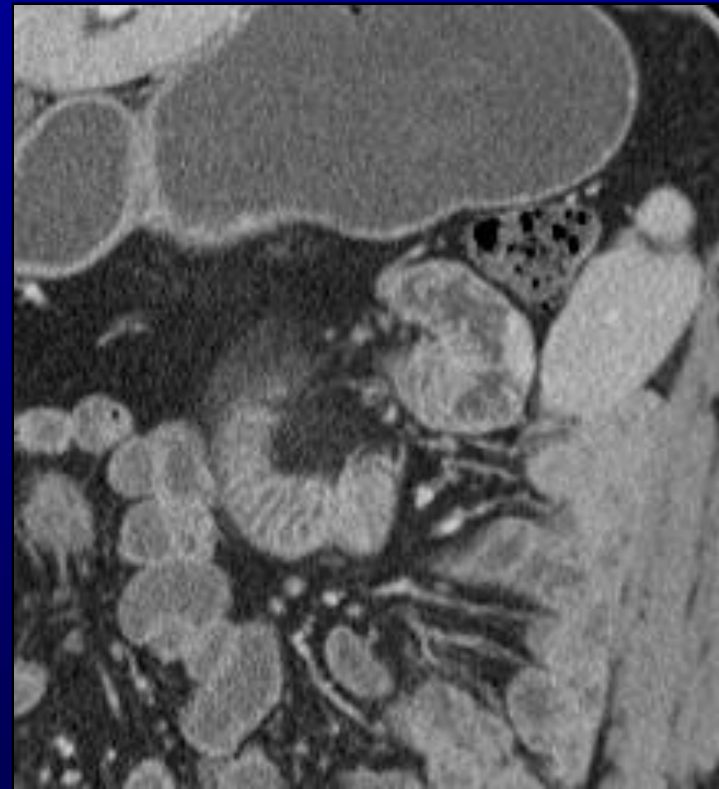
Courtesy Dr. Jim Huprich



Don't Give Me Any Coronal Image!



Axial



Coronal

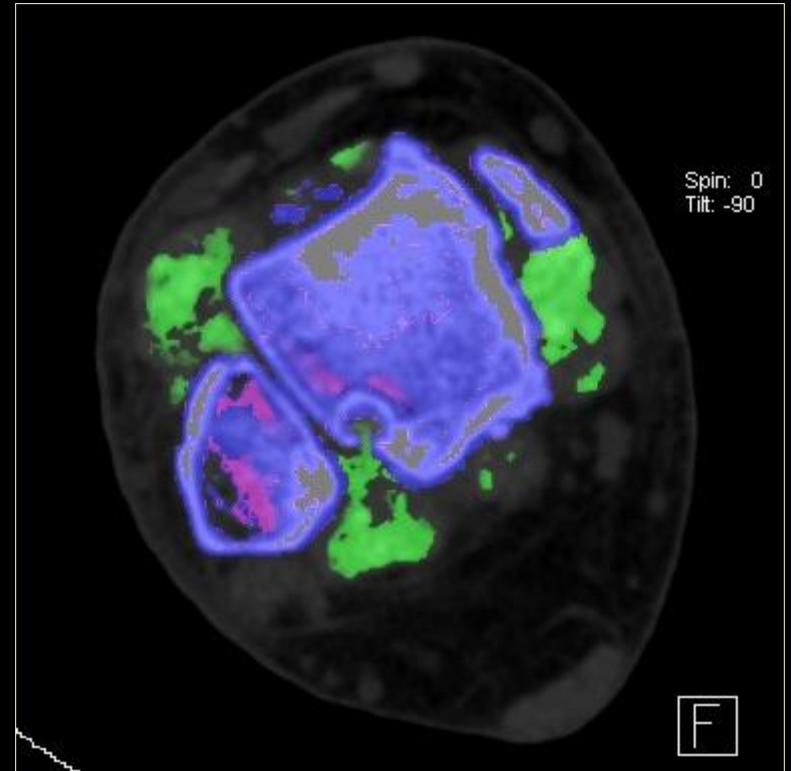
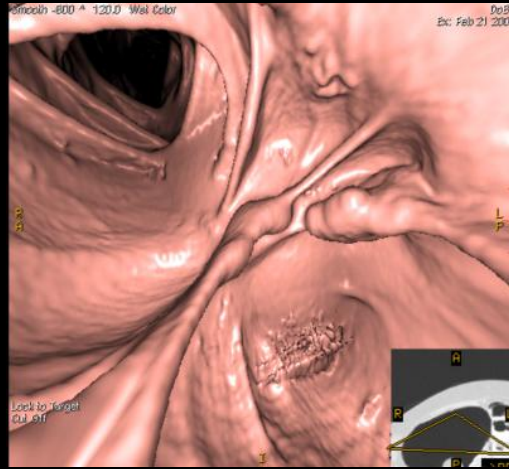
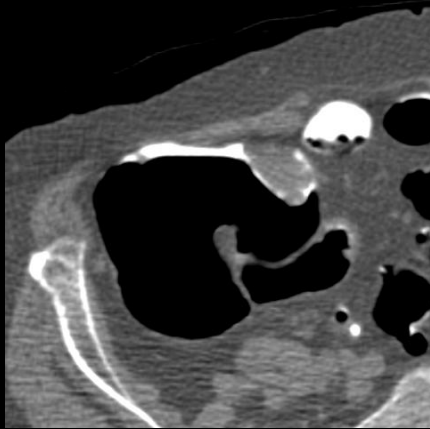
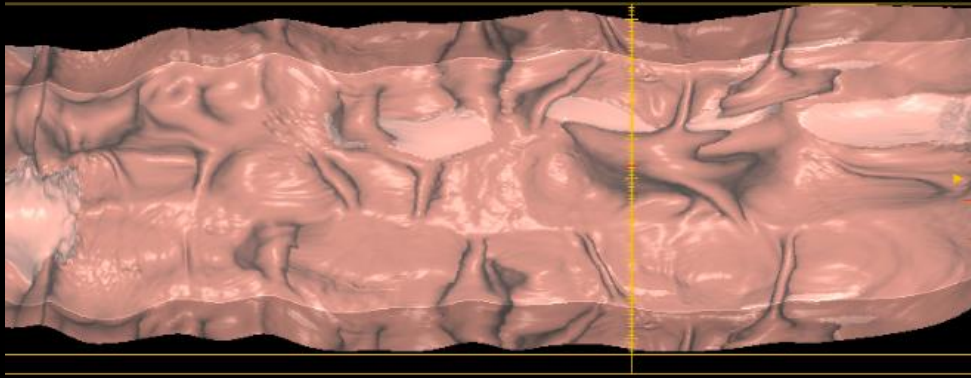


Image reconstruction and post-processing improve benefit



Optimization

Superfluous Series

Easiest way to minimize dose
without affecting diagnostic
accuracy is to eliminate phases that
do not contribute to diagnosis



Optimization

Superfluous Series

Non-contrast series in multiphase exam

- Useful for renal stones, initial pancreatitis (CBD stone)
- Generally not useful
 - Multiphase liver imaging*
 - F/U pancreatitis
 - Pancreatic mass evaluation

* Ianaconne et al. Radiology 2005; 234: 460 – 7; Doyle et al. JCAT 2007; 31: 86 – 92; Denecke T et al. Transp Int 2009 (epub)



Optimization

Superfluous Series

Delayed series in multiphase exam

- Useful for
 - urothelial neoplasm
 - Tumor “washout” – HCC, RCC
 - Post-op GU
- Generally unhelpful
- Appropriateness guidelines often comment



Optimization

Follow-up Exams

- Renal stone protocol – low dose
- Pancreatitis - single phase
- Other tumors – single phase



Optimization

*Maximizing disease detection while
minimizing dose and non-radiation risk*

- CT acquisition
- Patient preparation
- Visual assessment
- CT dose

Impact of acquisition and
visual assessment
modifies both risk and
benefit.

timing

contrast

relevant

– radiologist review

– image reconstruction & post-processing (3D, 2D MPR, DE)



Individualization



Individualization



Your Scanner and Allied Health Staff



COMPUTED TOMOGRAPHY

eProtocol System

PROTOCOLS

Abdominal

Cardiac

Musculoskeletal

Neuro

Research

Thoracic

Vascular

PROTOCOL SUPPLEMENTS

NEW Biopsy Mode Information

NEW Line Placement Verification

Miscellaneous Information

Nursing Information

Technique Charts

TUTORIALS AND REVIEWS

Scanning Larger Patients

Reformatting

Bellows System

Neuro PCT Analysis

NEWS AND ANNOUNCEMENTS



QUICK REFERENCE

Exams for Advanced Imaging Processing Lab (AIPL/3D)

Film Printing Instructions

Heart Anatomy

Lead Shielding Policy

Metric Conversion Chart

Networking

No Charge Billing

Radiographic Anatomy

Scanner Startup/Shutdown

Shutdown with Maintenance

Temporal Bone CT Anatomy

PHYSICS FLASH CARD

AcroPDFM

ER PATIENT?

N'T CLICK THROUGH THE WARNING!

Follow these steps to get more photons, in an order that makes the most sense for the specific exam.

- Decrease pitch
(will increase scan time)
- Increase collimation, then decrease pitch (increases min. slice width)
- Increase kV
(need to set new mAs)
- Increase rotation time
(will increase scan time)

If the acquired scans are too noisy, try the following.

- Use a smoother kernel
(B10, B20, if rings use B18)
- Recon to thicker slices

See the updated Scanning Larger Patients instructions for more info.

IN-SERVICE

"Imaging Economics 101" in the Mayo 16 Lecture Hall at 7am on April 9, 2010 with Dr. T. Welch speaking

BIOPSIES ANYBODY ????

New info regarding biopsies in the Biopsy Mode Techniques – new links and great reminders

Any suggestions for improving the eProtocols? Send a note to us at:

Radiology CT Protocol

(in Outlook's global address list)

Please restart the eProtocol viewers every morning!
[Click for more info.](#)



ABDOMINAL PROTOCOLS

Abdomen & Pelvis – Routine

Adrenals – Targeted/Thin

**Colonography – Routine &
Failed Colonoscopy**

**Colonography – w/ Contrast for
Colorectal Lesion**

Cystogram

**Enteroclysis – with Neutral Enteric
Contrast**

**Enteroclysis – with Positive Enteric
Contrast**

Enterography (Single Phase)

Enterography LD (Single Phase)

**Enterography (Bi-Phase) –
For Mesenteric Ischemia**

**Enterography (Tri-Phase) – For GI
Bleeding**

Esophageal Cancer Staging

ABDOMINAL PROTOCOLS

**Kidney – Triphase – Renal Mass, Pre
& Initial Post Ablation, and Partial
Nephrectomy**

**Kidney Biphasic – FU RCC Radical
Nephrectomy, 2nd Post Ablation,
and Partial Nephrectomy**

**Kidney – (CTA and Venous) Pre Op
Vascular Mapping**

Kidney – Renal Stone

Kidney – Renal Stone Composition (DE)

Kidney – Renal Stone, Low Dose

Kidney – Renal Stone Quantification

Liver – Bi-Phase

Liver – Cholangiogram (Siemens)

**Liver – Tri-Phase for Cirrhosis, HCC,
and Hepatoma**

Liver – HHT

Liver – Living Donor (Pre-Op) (Siemens)

Liver – Living Donor (Post-Op) (Siemens)

Liver – Post-Ablation

Liver – Pre-Ablation

Liver – Volumetric Pre hepatic

ABDOMINAL PROTOCOLS

Pancreas – Acute Pancreatitis

Pancreas – Bi-Phase

Pancreas – Bi-Phase w/ 3D Pancreatogram

Pancreas – Tri-Phase for Islet Cell

Pancreas – Single Phase for Follow Up

Prostate – Seed (Pre and Post Implant)

Prostate – Seed (Placement)

CTU/CTA - Renal Donor

CTU – Type I

CTU – Type II

CTU – Type III

CTU – Type IV

CTU – Type V



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Pancreas – Bi-Phase w/ 3D Pancreatogram

Pancreas – Tri-Phase for Islet Cell

Pancreas – Single Phase for Follow Up

Prostate – Seed (Pre and Post Implant)

Prostate – Seed (Placement)

CTU/CTA - Renal Donor

CTU – Type I

CTU – Type II

CTU – Type III

CTU – Type IV

CTU – Type V



[«Home»](#)

ENTEROGRAPHY SINGLE PHASE PROTOCOLS

STANDARD ADULT (06_1)

GE	8	16 (3M)	16 (4C)	64		
Siemens	16	40	64	Def-64	Def-AS+	F-128

PEDIATRIC (P02_0)

Siemens	Def-64	F-128	For patients 22-45 kg
Siemens FLASH Mode		F-128	For patients 22-45 kg

DUAL SOURCE (DS06_1)

Siemens (80/80)	Def-DS
Siemens (100/100)	F-128

DUAL ENERGY (DE06_1)

Siemens	Def-DE
---------	--------

Scheduling

[«Home»](#)

ENTEROGRAPHY-TRIPHASE-GI-BLEEDING

STANDARD ADULT (06_2)

GE	64			
SIEMENS	64	Def-64	Def-AS+	F-128

DUAL SOURCE (DS06_2)

SIEMENS (80/80)	Def-64	Patients with a lateral width of less than 32cm and who cannot have
SIEMENS (100/100)	Def-64	Patients with a lateral width of 32-42 cm and who cannot have a full
SIEMENS (120/120)	Def-64	

DUAL ENERGY (DE06_2)

SIEMENS (100/140sn)	F-128
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◀ Home ▶

◀ LIST ▶

ENTEROGRAPHY SINGLE PHASE

(With out Blood loss)

GENERAL: Indications include, but are not limited to, Crohn's and Sprue.
Patients will be arriving 75 min. before their appointment time.

CONTRAST: Oral: IV must be in place **BEFORE** the patient is given oral contrast. Nurse will give the following oral contrast to the patient.

Routine Patient	ER Patient
450mL Volumen, 60 min prior to CT	1.8-2.0 liters of water over 30min.
450mL Volumen, 45 min prior to CT	Scan the patient 75min after the start of drinking water.
450 mL Volumen, 30 min prior to CT	
500 mL or 2 glasses of water, 15 min prior to CT	

IV: Use weight-based chart. Standard is 150ml Omnipaque 300 at 4cc/sec.

For large patients consult with radiologist regarding increasing contrast dosage.

Consult with radiologist regarding use of Reglan.

Good coordination is critical for this timed study.

TOPOGRAM: PA, 512. **STOP SCAN** when through pelvis.

INFORM THE RADIOLOGIST IF ANY RESIDUAL BARIUM ON THE SCOUT/TOPOGRAM.

IF PATIENTS ARE: <45CM please use 2 mm x 1 mm slice thickness and increment.

IF PATIENTS ARE: >45 CM please use 3x2 slice thickness and Increment.

If B43 is not available please use the B40 kernel.

ENTEROGRAPHY: Scan from top of liver through Perineum. Do in one breath-hold (patient can breathe out slowly if necessary).

SIEMENS	Sens-16	Sens-40	Sens-64	Def-64	Def-AS+	F-128
Scan Type	Spiral	Spiral	Spiral	Spiral	Spiral	Spiral
Rotation Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Collimation	16 x 0.75	40 x 0.6	64 x 0.6	64 x 0.6	128 x 0.6	128 x 0.6
Pitch	0.7	0.6	0.8	0.8	1	1
Feed (mm/rot)	12	7.2	15.3	15.3	15.3	15.3
kVp	120	120	120	120	120	120
Quality ref mAs	240	200	240	240	240	240
CARE Dose 4D	ON	ON	ON	ON	ON	ON
API	inspiration	inspiration	inspiration	inspiration	inspiration	inspiration
Prep Delay (s)	50	50	50	50	50	50
Min. Retro (mm)	0.75	0.6	0.6	0.6	0.6	0.6
CTDI (mGy)	19	21.72	18	18	18	16.19
Base Protocol	Abd Routine	Abd Routine	Abd Routine	Abd Routine	Abd Routine	Abd Routine



Daily and ongoing commitment



Individualization



Requires Planning by Integrated Team
MD's, PhD's, RT's, RN's



What is “diagnostic image quality”?

“I know it when I see it.”

Justice Potter Stewart
U.S. Supreme Court



What is “diagnostic image quality”?

- Often graded on a 5 – point scale
 - Definitions vary
 - Reproducibility often “good”
- Sometimes accompanied by
 - Other subjective scales such as
 - Artifact scores
 - Diagnostic confidence scores
 - *Subjective Sharpness, Conspicuity, Noise \pm Noise texture*
 - Objective measures
 - Noise & contrast measurements
 - *Gradient sharpness*



What is “diagnostic image quality”?

European Guidelines on Quality Criteria for CT*

- Visualization of fine detail (e.g., small vessels)
- Visually acceptable noise level (e.g., small vessels)
- Acquisition technique (e.g., slice thickness)
- Subjective assessment (e.g., “diagnostic quality”)

1 = too little noise
2 = just right, optimum noise
3 = too much noise affecting interpretation

** <http://www.drs.dk/guidelines/ct/quality/htmlindex.htm>

** Prakash, Kalra et al. Invest Radiol 2010; 45: 202–210



What is “diagnostic image quality”?

European Guidelines on Quality Criteria for CT*

- Visualization of critical structures
- Visually sharp reproduction of structures (small vessels and lymph nodes, vascular/organ edges)
- Acquisition: CTDI_{vol} 35 mGy; nominal slice thickness 7 – 10 mm; 3 - 5 mm “small lesions”
- Subjective Noise**: the 3 bears
- Diagnostic Confidence**: 4-point scale

**<http://www.drs.dk/guidelines/ct/quality/htmlindex.htm>

** Prakash, Kalra et al. Invest Radiol 2010; 45: 202–210



What is “diagnostic image quality”?

European Guidelines on Quality Criteria for CT*

- Great start
- Weaknesses
 - Too forgiving
 - Objective measures of sharpness, noise texture, low contrast conspicuity
 - Subjective measures of noise texture & conspicuity
 - Common image datasets
- Similar AAPM guidelines would be a boon to development, evaluation and validation of noise reduction technologies

**<http://www.drs.dk/guidelines/ct/quality/htmlindex.htm>

** Prakash, Kalra et al. Invest Radiol 2010; 45: 202–210



Getting a “Good Exam”

Example Patient Profile

28 yo with Peutz-Jehgers

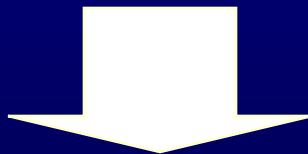
Looking for large/dysplastic small
bowel polyps



Getting a “Good Exam”

Example Patient Profile

- Small bowel “filling defect”
- Enhancement only important if IV contrast
- Bowel distention important
- Young patient likely to undergo multiple exams



- CT enteroclysis > CT enterography
- Positive oral contrast
- Minimal collimation < 1 mm, coronal recons; 2 mm axial slices
- Half-standard tube current



Conclusions

- CT imaging benefits patients
- *Net benefit* affected by
 - *Patient risk, appropriateness*
 - *Optimization of CT technique*
- Benefit maximized by individual consideration
 - *Protocol development incorporating CT acquisition, pt prep, visualization*
 - *Continuing commitment*

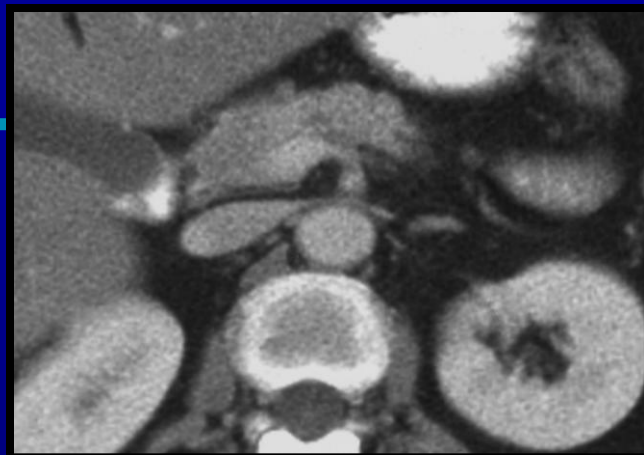
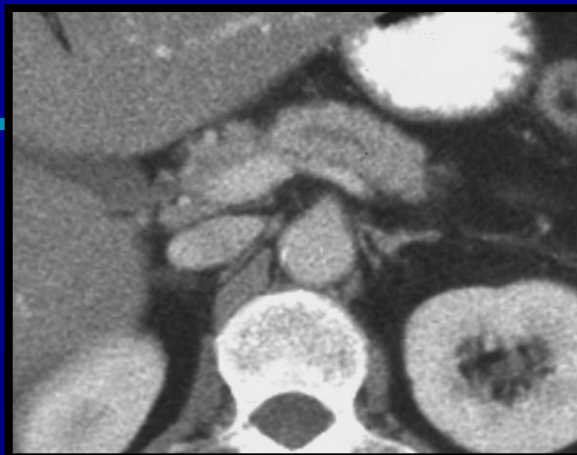
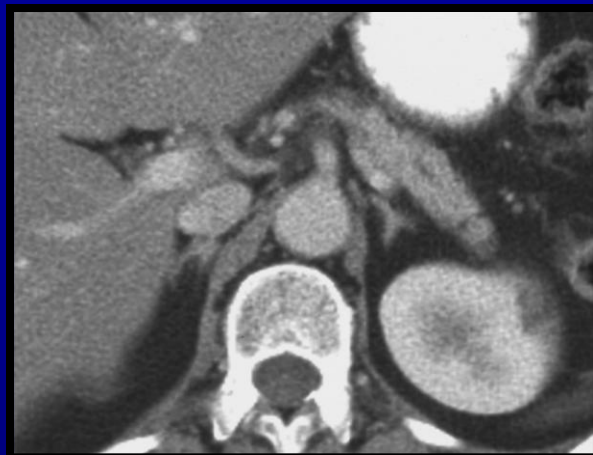


Suggested readings

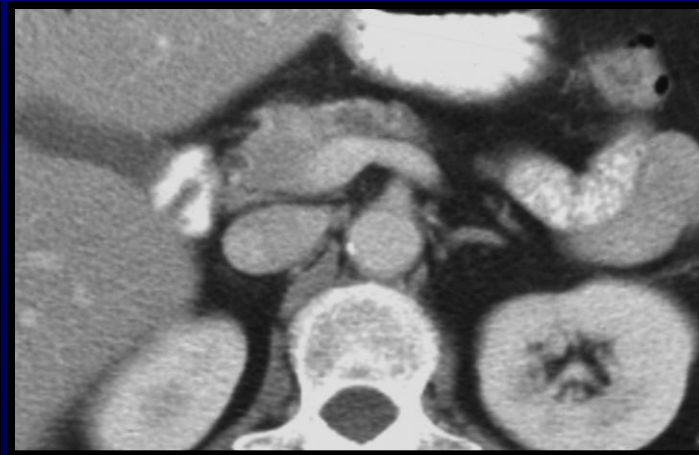
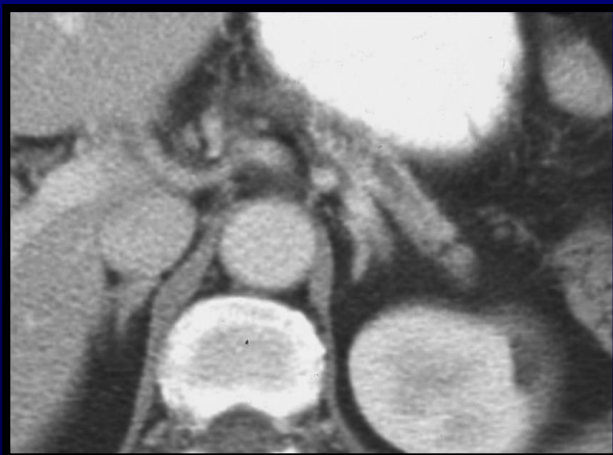
- ACR Appropriateness Criteria
 - http://www.acr.org/secondarymainmenucategories/quality_safety/app_criteria.aspx
- European Guidelines on Quality Criteria for CT
 - <http://www.drs.dk/guidelines/ct/quality/Preamble1.htm>
- ACR White Paper on Radiation Dose in Medicine
 - Amis ES et al. JACR 2007; 4: 272 – 284
- In Defense of Body CT
 - McCollough CH et al. AJR 2009; 193(1):28-39.



13 months prior



Led to diagnosis



Careful radiologist review improves benefit



Careful radiologist review improves benefit



Enteroclysis – with Neutral Enteric Contrast

**Low-grade
obstruction**

Enteroclysis – with Positive Enteric Contrast

**Polyposis,
obstruction**

Enterography (Single Phase)

Enterography LD (Single Phase)

**Crohn's, sprue,
diarrhea**

**Enterography (Bi-Phase) –
For Mesenteric Ischemia**

Ischemia

**Enterography (Tri-Phase) – For GI
Bleeding**

**Occult GI
blood loss**